

Open your book to page 327 and Warm Up on #1-3. Have your homework out ready for me to check.

Classwork - Nonlinear and Linear Functions

Find the rate of change (slope) and initial value (y-int) of each situation. Then write a function that represents the situation.

1. When Charlotte planted her tomato plant, it grew 3 inches in one week. After 5 weeks, the tomato plant was 23 inches tall. Assume the relationship is linear. Find and interpret the rate of change and the initial value.

$$m = 3 \quad x = 5 \quad y = 23$$

$$23 = 3(5) + b$$

$$23 = 15 + b$$

$$8 = b$$

The plant was 8 inches tall when she planted it and it grew 3 inches per week.

2. The total cost of renting a vacation home includes a deposit and a daily rental fee of \$125. A family rents a vacation home for 5 days and pays \$700. Assume the relationship is linear. Find and interpret the rate of change and the initial value.

$$m = 125 \quad x = 5 \quad y = 700$$

$$700 = 125(5) + b$$

$$700 = 625 + b$$

$$\begin{array}{r} 700 = 625 + b \\ -625 \quad -625 \\ \hline 75 = b \end{array}$$

There is a deposit of \$75 and rental fee of \$125 per day.

Rate of Change = 3 in/week

Initial Value = 8 inches

Function: $y = 3x + 8$

Rate of Change = \$125/day

Initial Value = \$75

Function: $y = 125x + 75$

3. In order to enter the state fair, there is an admission cost. Each game is \$3. Steven went to the state fair, played 4 games and spent a total of \$20 on admission and games. Assume the relationship is linear. Find and interpret the rate of change and the initial value.

$$m = 3 \quad x = 4 \quad y = 20$$

$$20 = 3(4) + b$$

$$20 = 12 + b$$

$$\begin{array}{r} -12 \\ -12 \end{array}$$

$$\hline 8 = b$$

Admission costs \$8 and games cost \$3 per game.

Rate of Change = $\frac{\$3}{\text{game}}$

Initial Value = $\frac{\$8}{}$

Function: $\underline{y = 3x + 8}$

4. After writing part of his novel, Thomas is now writing 16 pages per week. After 4 weeks, he has written 85 pages. Assume the relationship is linear. Find and interpret the rate of change and the initial value.

$$m = 16 \quad x = 4 \quad y = 85$$

$$85 = 16(4) + b$$

$$85 = 64 + b$$

$$\begin{array}{r} -64 \\ -64 \end{array}$$

$$\hline 21 = b$$

Thomas originally had 21 pages written then wrote 16 pages per week.

Rate of Change = $\frac{16 \text{ pages}}{\text{week}}$

Initial Value = $\frac{21 \text{ pages}}{}$

Function: $\underline{y = 16x + 21}$

5. A photographer charges \$20 for an 8×10 photo plus a sitting fee. Luann spent \$55 on two 8×10 photographs and the sitting fee. Assume the relationship is linear. Find and interpret the rate of change and the initial value.

$$m = 20 \quad x = 2 \quad y = 55$$

$$55 = 20(2) + b$$

$$55 = 40 + b$$

$$\begin{array}{r} -40 \quad -40 \\ \hline \end{array}$$

$$15 = b$$

The sitting fee cost \$15 and each photo costs \$20.

Rate of Change = \$20/photo

Initial Value = \$15

Function: $y = 20x + 15$

6. To perform car maintenance, a mechanic charges for parts and \$45 an hour for labor. The total cost that Terri spent for 2 hour of car maintenance is \$125. Assume the relationship is linear. Find and interpret the rate of change and the initial value.

$$m = 45 \quad x = 2 \quad y = 125$$

$$125 = 45(2) + b$$

$$125 = 90 + b$$

$$\begin{array}{r} -90 \quad -90 \\ \hline \end{array}$$

$$35 = b$$

It costs \$35 for parts and \$45 for each hour of labor.

Rate of Change = \$45/hour

Initial Value = \$35

Function: $y = 45x + 35$



Real-World Link



Football The table shows the approximate height and horizontal distance traveled by a football kicked at an angle of 30° with an initial velocity of 30 yards per second.

1. Is the rate of change for the height of the football constant? Explain.

No

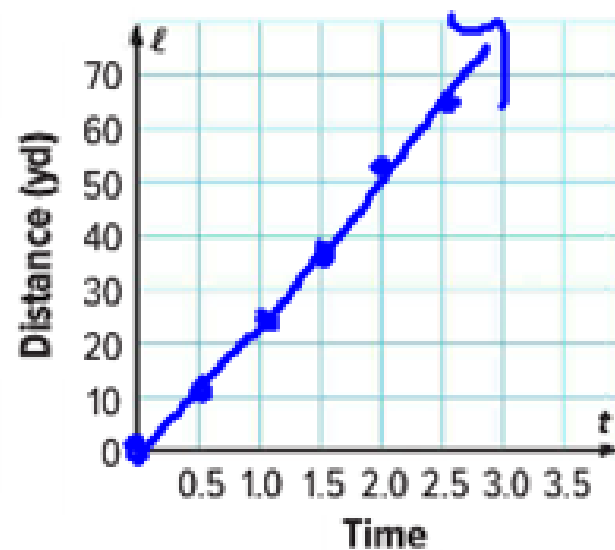
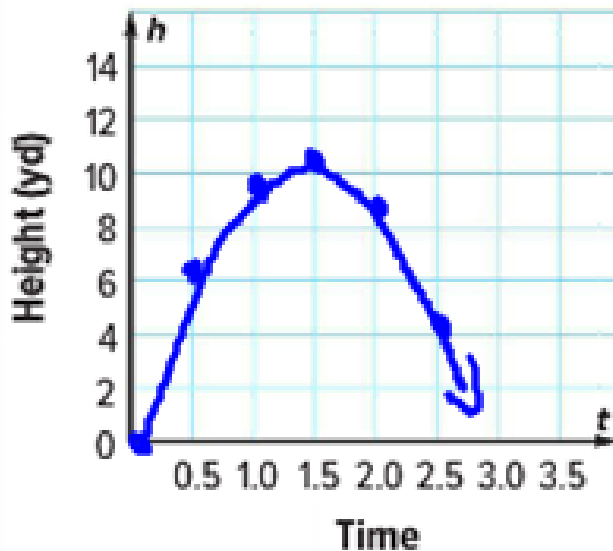
2. Is the rate of change for the distance traveled constant? Explain.

Yes

Time (s)	Height (yd)	Distance (yd)
0.0	0	0
0.5	6.2	13
1.0	9.7	26
1.5	10.5	39
2.0	8.7	52
2.5	4.2	65

Handwritten notes: $30 \times 0.5 = 15$, $30 \times 1.0 = 30$, $30 \times 1.5 = 45$, $30 \times 2.0 = 60$, $30 \times 2.5 = 75$

3. Graph the ordered pairs (time, height) and (time, distance) on separate grids. Connect the points with a straight line or smooth curve. Then compare the graphs.



Identify Linear and Nonlinear Functions

In a previous lesson, you learned that linear functions have graphs that are straight lines. This is because the rate of change between any two data points is a constant. **Nonlinear functions** are functions whose rates of change are not constant. Therefore, their graphs are not straight lines.

Examples



Determine whether each table represents a *linear* or *nonlinear* function. Explain.

1.

x	y
2	50
4	35
6	20
8	5

+2 { -15
+2 { -15
+2 { -15

As x increases by 2, y decreases by 15 each time. The rate of change is constant, so this function is linear.

2.

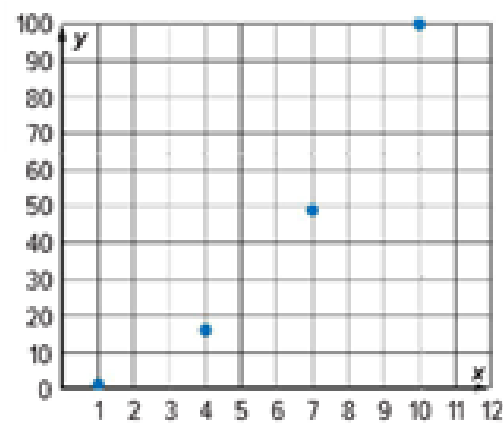
x	y
1	1
4	16
7	49
10	100

+3 { +15
+3 { +33
+3 { +51

As x increases by 3, y increases by a greater amount each time. The rate of change is not a constant, so this function is nonlinear.

Check

Graph the points on a coordinate plane.



The points do not fall in a line. The function is nonlinear. ✓

Got it? Do these problems to find out.

Determine whether each table represents a *linear* or *nonlinear* function. Explain.

a.

x	0	5	10	15
y	20	16	12	8

$+5 +5 +5$
 $-4 -4 -4$

b.

x	0	2	4	6
y	0	2	8	18

$+2 +2 +2$
 $+2 +4 +6$

Linear
As x increases by 5,
 y decreases by 4 each
time.

Nonlinear
As x increases by 2,
 y increases by a different
amount each time.



Example



3. Use the table to determine whether the minimum number of Calories a tiger cub should eat is a linear function of its age in weeks.

Use the table to find the rates of change.

$$1,000 - 825 = 175$$

$$1,185 - 1,000 = 185$$

$$1,320 - 1,185 = 135$$

$$1,420 - 1,320 = 100$$

+1
+1
+1

Age (weeks)	Minimum Calorie Intake
1	825
2	1,000
3	1,185
4	1,320
5	1,420

+175
+185
+135

The rates of change are not the same. Therefore, this function is nonlinear.

Check Graph the data to verify the ordered pairs do not lie on a straight line.

Got it? Do this problem to find out.

c. Tickets to the school dance cost \$5 per student. Are the ticket sales a linear function of the number of tickets sold? Explain.

+1 +1

Number of Tickets Sold	1	2	3
Ticket Sales	\$5	\$10	\$15

+5 +5

Yes, as the tickets increase by 1, the sales is increasing by \$5.



Example



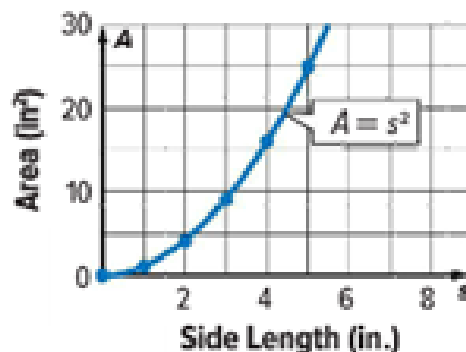
4. A square has a side length of s inches. The area of the square is a function of the side length. Does this situation represent a linear or nonlinear function? Explain.

Make a table to show the area of the square for side lengths of 1, 2, 3, 4, and 5 inches.

Side Length (in.)	1	2	3	4	5
Area (in ²)	1	4	9	16	25

+3 +5 +7

Graph the function. The function is not linear because the points (1, 1), (2, 4), (3, 9), (4, 16), and (5, 25) are not on a straight line.



Got it? Do this problem to find out.

- d. A square has a side length of s inches. The perimeter of the square is a function of the side length. Does this situation represent a linear or nonlinear function? Explain.

$p = 4s$ Make a table using the function.

s	1	2	3	4
p	4	8	12	16

Linear, as the side length increases by 1 unit, the perimeter increases by 4 each time.